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## Foodborne Disease Outbreaks in Correctional Institutions—United States, 1998–2014

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### Abstract

**Objectives—**To present the first update on the epidemiology of US foodborne correctional institution outbreaks in 20 years.

**Methods—**We analyzed data from the Centers for Disease Control and Prevention's Foodborne Disease Outbreak Surveillance System to describe correctional institution outbreaks from 1998 to 2014 and compare them with other foodborne outbreaks.

**Results—**Two hundred foodborne outbreaks in correctional institutions were reported, resulting in 20 625 illnesses, 204 hospitalizations, and 5 deaths. Median number of outbreak-associated illnesses per 100 000 population per year was 45 (range = 11–141) compared with 7 (range = 4–10) for other outbreaks. These outbreaks accounted for 6% (20 625 of 358 330) of outbreak-associated foodborne illnesses. Thirty-seven states reported at least 1 outbreak in a correctional institution. *Clostridium perfringens* (28%; 36 of 128) was the most frequently reported single etiology. The most frequently reported contributing factor was food remaining at room temperature (37%; 28 of 76).

**Conclusions—**Incarcerated persons suffer a disproportionate number of outbreak-associated foodborne illnesses. Better food safety oversight and regulation in correctional food services could decrease outbreaks.

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### CONTRIBUTORS

M. A. Marlow, R. E. Luna-Gierke, and A. R. Vieira planned the analyses. M. A. Marlow conducted the data analyses. All of the authors contributed to writing the article.

**Note:** The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the CDC. References to specific commercial products, manufacturers, companies, or trademarks do not constitute their endorsement or recommendation by the US government, Department of Health and Human Services, or the CDC.

### HUMAN PARTICIPANT PROTECTION

Institutional review board approval was not required. Only aggregate outbreak publicly available data were used.

**Public Health Implications**—Public health officials, correctional officials, and food suppliers can work together for food safety. Clearer jurisdiction over regulation of correctional food services is needed.

The estimated US incarcerated population nearly doubled from 1.2 million in 1991 to 2.2 million in 2014 to become the largest in the world.<sup>1,2</sup> Persons admitted each year to US jails for 1 or more days also increased from an estimated 10.3 million to 11.4 million during this time.<sup>3,4</sup> In comparison with the general population, inmates have an increased risk for infection related to features common in correctional institution settings, including crowding, lack of sufficient hand-washing areas, poor hygiene practices, and lack of sufficient training in sanitation and disease prevention for inmates.<sup>5</sup> For these and other reasons, correctional institution-associated, or “desmoteric,” outbreaks present unique challenges to disease prevention and control.

Inmates rely on the correctional institution system for their food and usually form a large part of the correctional food service workforce. Correctional institution administrators set the budget for all food-related activities, including the hiring of food safety managers and training of workers. They also decide which foods to buy, which suppliers to use, and who will prepare and serve food. In 1996, Cieslak et al. first described the epidemiology of US foodborne disease outbreaks in correctional institutions from 1974 to 1991.<sup>6</sup> In the report, desmoteric outbreaks made up 1% of all foodborne outbreaks reported and 5% of all foodborne outbreak-associated illnesses. This was more than twice as many illnesses as attributed to foodborne outbreaks in US nursing homes during a similar time period.<sup>7</sup> The report also warned that the rising correctional population could lead to a rise in outbreaks. The United States now has approximately 5000 city, county, and privately operated jail facilities and state and federal correctional facilities.<sup>8,9</sup> These institutions provide a public health opportunity for development and evaluation of targeted interventions that could reduce foodborne illnesses and decrease the burden of these illnesses on the correctional system and US taxpayers.

We describe epidemiological data on foodborne disease desmoteric outbreaks reported to the Foodborne Disease Outbreak Surveillance System (FDOSS) of the Centers for Disease Control and Prevention (CDC) from 1998 through 2014, and compare these outbreaks with all other foodborne outbreaks.

## METHODS

A foodborne disease outbreak is defined by CDC as the occurrence of 2 or more similar illnesses resulting from ingestion of a common food.<sup>10</sup> Local, state, and territorial health departments report foodborne disease outbreaks through a Web-based standardized form to FDOSS. This analysis includes all outbreaks with first illness onset date from January 1998 through December 2014 that were reported as of August 2015. Information collected for each outbreak includes number of illnesses, hospitalizations, deaths, reporting state, settings of food preparation and consumption, contributing factors, etiological agent, and implicated food vehicle.

We defined desmoteretic outbreaks as outbreaks in which consumption of food occurred in correctional institutions, which include prisons and jails, and other outbreaks as all other foodborne outbreaks, regardless of location. We considered an etiologic agent as confirmed on the basis of published criteria<sup>11,12</sup> and a food vehicle as implicated when the outbreak report stated at least 1 of the following reasons for implicating the food item(s): (1) statistical evidence from an epidemiological investigation, (2) laboratory evidence identifying the etiologic agent in the implicated food, and (3) compelling or other supportive data. We summarized the information collected for desmoteretic outbreaks and compared it with data from all other outbreaks. We used the Federal Bureau of Justice Statistics incarcerated population estimates (available at <https://www.bjs.gov>) to calculate desmoteretic outbreak—associated illnesses per 100 000 incarcerated population and the US Census Bureau population estimates (available at <https://www.census.gov>), subtracting incarcerated population estimates, to calculate other outbreak-associated illnesses per nonincarcerated population. We performed all analyses in SAS version 9.3 (SAS Institute Inc, Cary, NC).

## RESULTS

From 1998 to 2014, US health departments reported 200 foodborne disease desmoteretic outbreaks, resulting in 20 625 illnesses, 204 hospitalizations, and 5 deaths (Table 1). A median of 12 (range = 7–19) foodborne desmoteretic outbreaks per year were reported. These outbreaks accounted for 1% (200 of 18 206) of all foodborne disease outbreaks reported, 6% (20 625 of 358 330) of outbreak-associated illnesses, 1% (204 of 13 710) of hospitalizations, and 2% (5 of 319) of deaths. Median number of illnesses per outbreak (44; range = 2–1644) and median number of outbreak-associated illnesses per 100 000 population (45; range = 11–141) were more than 5-fold larger in desmoteretic outbreaks than in other outbreaks (8; range = 2–1939 and 7; range = 4–10, respectively; Table 1). Desmoteretic outbreaks were also the largest foodborne outbreaks reported in 4 of the 17 study years and among the top 5 largest outbreaks in 6 other years. Thirty-seven states reported at least 1 outbreak in a correctional institution. The states reporting the most outbreaks were Florida (12%; n = 23) and California (11%; n = 22).

Of the 200 foodborne desmoteretic outbreaks, 64% (128) had a confirmed single etiology compared with 41% of non-desmoteretic foodborne outbreaks (7353 of 18 006). Confirmed etiologic agents that caused the most outbreaks were *Clostridium perfringens* (28%; n = 36), *Salmonella* (27%; n = 35), and norovirus (16%; n = 21; Table 2; Figure A, available as a supplement to the online version of this article at <http://www.ajph.org>). In comparison, norovirus (40%; n = 2910), *Salmonella* (27%; n = 1955), and *Escherichia coli* (6%; n = 422) were the most frequent etiologies and *C. perfringens* accounted for only 4% (n = 307) of other outbreaks. The median number of illnesses in desmoteretic outbreaks caused by *C. perfringens* (94; range = 10–950) was more than 3 times higher than in desmoteretic outbreaks of *Salmonella* infections (24; range = 3–552). Total illnesses were almost double in desmoteretic outbreaks caused by *C. perfringens* compared with *Salmonella* (5566 and 2848, respectively). The 5 deaths resulted from 2 *Salmonella* outbreaks. Four were associated with an outbreak of *Salmonella* serotype *typhimurium* infections from pico de gallo served in a Texas correctional facility in 2001 and 1 with an outbreak of *Salmonella* serotype *miami*

infections in a Tennessee correctional facility in 2002 for which no food source was implicated.

Food was prepared at the correctional institution in 89% (178 of 200) of outbreaks. Food-handler(s) were implicated as the source of contamination in 14% (28 of 199) of desmoteric outbreaks, similar to 13% (2348 of 17 754) of other outbreaks. Contributing factors were reported in only 38% (76 of 200) of desmoteric outbreaks. The most frequently reported factors were allowing foods to remain at room or warm outdoor temperature for several hours (37%; n = 28), handling by an infected person or carrier (26%; n = 20), and inadequate cleaning of processing or preparation equipment or utensils (24%; n = 18). Among the 5069 (28%) other outbreaks with contributing factors reported, the top 2 factors were the same (infected food handler [31%; n = 1546] and food at room temperature [28%; n = 1409]). However, the third most common factor among other outbreaks was inadequate cold-holding temperatures (24%; n = 1194), which was a factor in only 16% (n = 12) of correctional institution outbreaks.

A food source was implicated in 41% (82 of 200) of desmoteric outbreaks compared with 38% (6754 of 18 006) of other outbreaks. The proportion of outbreaks linked to poultry (20%; 16 of 82) was nearly 3 times higher in correctional institutions than in other outbreaks (7%; 469 of 6754), whereas the proportion of outbreaks that were fish-associated (4%; 3 of 82) was about 3 times lower (10%; 663 of 6754; Table 3). Other implicated foods in desmoteric outbreaks were vegetables (11%; n = 9), meat (9%; n = 7), and dairy (6%; n = 5). For outbreaks with a confirmed etiology, 26% (33 of 128) of correctional outbreaks and 16% (1142 of 7353) of other outbreaks had a positive food specimen.

Of the 55 outbreaks with known single etiology and food source, outbreaks of *C. perfringens* infections were most frequently traced to foods composed of several food categories (57%; 13 of 23) and meat (17%; 4 of 23). For outbreaks with confirmed *C. perfringens* etiology, 64% (23 of 55) of correctional outbreaks and 66% (202 of 3190) of other outbreaks had an implicated food source, either by epidemiological evidence or laboratory evidence. Among the 33 correctional outbreaks with confirmed etiology and a positive food specimen, 55% (n = 18) were *C. perfringens*, compared with 15% (174 of 1142) for other outbreaks. A food source was implicated in only 8 (23%) of the 35 correctional institution outbreaks of *Salmonella* infections compared with 822 (44%) of 1853 other outbreaks (Table A, available as a supplement to the online version of this article at <http://www.ajph.org>). *Salmonella* outbreaks in correctional institutions were associated with poultry (66%; 6 [4 chicken, 2 turkey] of 8) and eggs (13%; 1 of 8); 1 food source was unclassifiable. Three of the 4 dairy desmoteric outbreaks were caused by *Campylobacter*.

Food that was illicitly obtained or prepared was reported in 16 outbreaks. Half of these outbreaks with known etiology (50%; 7 of 14) were caused by *Salmonella*. Four outbreaks of botulism were caused by consumption of pruno, an illicit alcoholic beverage prepared by inmates. After pruno, chicken (n = 3) was the second most frequently implicated illicit food.

## DISCUSSION

Inmates have no choice in where and little choice in what they eat; they are completely dependent on institutional food safety procedures. Correctional foodborne outbreaks were routinely among some of the largest outbreaks each year, representing a single target for preventing large numbers of illness. Our results show that incarcerated persons suffered more than 6 times more outbreak-associated foodborne illnesses per population than did nonincarcerated persons. In 2014, approximately 1 in every 3000 inmates was part of a recognized foodborne disease outbreak compared with 1 in every 25 000 nonincarcerated persons.<sup>13,14</sup> Similar to the report for 1974 to 1991,<sup>6</sup> foodborne disease outbreaks in US correctional institutions continued to account for 1% of all outbreaks and about 6% of all outbreak-associated illnesses from 1998 through 2014. The median number of foodborne desmoteriic outbreaks reported per year increased from 5 (range = 1–11) from 1974 to 1991<sup>6</sup> to 12 (range = 7–19) from 1998 to 2014. However, the number of all outbreaks reported each year doubled in 1998 when FDOSS transferred to electronic records<sup>15</sup> and the prison population increased about 3-fold between 1983 and 2006.<sup>16,17</sup>

If the cost for foodborne illness among inmates was similar to that estimated for other persons (estimated \$1068 [90% confidence interval = \$683, \$1646]<sup>18</sup>), foodborne desmoteriic outbreaks may have cost the US economy an estimated \$22 million (\$14.1 million to \$33.9 million) from 1998 through 2014. This cost represents only illnesses from reported outbreaks, and many more foodborne illnesses that are not part of recognized outbreaks likely occur as well. A portion of this cost is incurred by tax payers rather than consumers.

Whereas investigators more often identified the etiology, contributing factors, and implicated food source of desmoteriic than other outbreaks, improvement is needed given etiology was known in fewer than two thirds, contributing factors in about one third, and food source in fewer than half. Outside the correctional institution setting, detecting a foodborne outbreak and identifying its source can be difficult, especially when patients do not seek health care, have trouble recalling what they ate before illness, or have consumed many different foods in many different settings, or when traceback for suspected items is not available. The correctional institution setting eliminates some of these barriers, and investigators may have access to patients' medical records, clinical specimens, environmental and food samples, and data on the institution's food supply. Some correctional institutions keep a tray of food for a few days, sometimes referred to a "dead man's tray," for testing purposes if food poisoning occurs. However, investigating these outbreaks can be difficult for several reasons. For example, a large study may be needed to detect differences in consumption among inmates offered limited food items; some institutions may be slow to reach out for assistance from outside agencies,<sup>5</sup> delaying testing and increasing potential recall bias in interviews; and inmates may under- or overreport symptoms, making case ascertainment difficult.

*C. perfringens* caused a substantial proportion of desmoteriic outbreaks and illnesses. The most common contributing factor (inadequate holding temperature) and the most common food category (poultry) in correctional institution outbreaks are typical for outbreaks of *C. perfringens* infections.<sup>19</sup> From 1998 to 2010, the 2 largest outbreaks caused by *C.*

*perfringens* occurred in correctional institutions.<sup>20</sup> *C. perfringens* spores can survive high cooking temperatures and germinate, particularly in meat and poultry products,<sup>19,20</sup> and the bacteria can then rapidly proliferate when food is held for too long at a warm temperature.<sup>21</sup> *C. perfringens* is often responsible for outbreaks that result from food prepared in bulk and stored before serving, as is commonly the case in correctional institution kitchens and cafeterias. This emphasizes the importance of short holding times, proper holding temperatures, and adequate refrigerator space for rapid cooling and storage as key food safety measures in correctional institutions. The logistics of feeding a large number of inmates likely contribute to these outbreaks. The high number of reported outbreaks of *C. perfringens* infections may also result from practice of keeping dead man's trays, as *C. perfringens* is more frequently tested in food than in clinical specimens. Compared with other outbreaks, correctional outbreaks with a confirmed etiology more frequently had a positive food specimen, and of those, the proportion that were *C. perfringens* outbreaks was more than 3-fold higher.

The comparatively lower number of norovirus desmoteric outbreaks may indicate a lack of testing when norovirus is suspected and determined to be foodborne. Norovirus illnesses generally last only 2 days, and testing was not widely available beyond public health laboratories during most of the time period.

All incarcerated persons are under the custody of the state and must report their foodborne illness to the correctional facility medical unit. The correctional institution administration oversees the reporting of these illnesses to the state or local health department and maintenance of food safety. Under the 1996 Prison Litigation Reform Act, prisoners must first exhaust all remedies set forth by their institution's administration before bringing suit for violation of their constitutional right prohibiting cruel and unusual punishment.<sup>22</sup> In the case of poor conditions or unsafe practices in food service, a prisoner must first report these issues to the administration and await their intervention before seeking legal intervention. Food service inspections may be conducted by correctional officials, a private accreditor or consultant, or the state or local health department, usually at the invitation of the administration unless mandated by a court. Together, this gives inmates less access than the general public to report foodborne illness directly to a state or local health department and gives correctional institutions more autonomy than other food establishments in maintaining food safety standards.

### Food Service Guidelines

State and local health departments can adopt the US Food and Drug Administration (FDA) Food Code as a model for their food safety guidelines to comply with national policy guidelines. Federal correctional institutions are required to follow food safety guidelines set forth by the Federal Bureau of Prisons (BoP) Food Service Manual.<sup>23</sup> In this manual, a Food Service Administrator (FSA), the highest-level food service staff at the institution level, is required to make the FDA Food Code available to staff but does not have to make it a binding document. State and local correctional institutions can create their own guidelines, which are often adapted from the BoP manual or the state code for retail food establishments. Four FDA Food Code provisions are highlighted by CDC to prevent

foodborne illness: (1) requiring food service employees to wash their hands, (2) prohibiting bare hand contact with ready-to-eat food, (3) excluding ill food service staff from working until at least 24 hours after symptoms such as vomiting and diarrhea have ended, and (4) requiring at least 1 employee in a food service establishment to be a certified food protection manager.<sup>24</sup>

The first 2 provisions on hand washing and bare hand contact are stated clearly in the BoP manual. It is not clear whether the third provision is mandated. Federal institution food service staff must monitor inmates for obvious health conditions and hygiene. The BoP manual says that if an inmate reports or is observed to have symptoms (examples given are “open sores, skin irritations, cold or flu symptoms, yellow eyes or jaundiced skin, etc.”), they are referred to Health Services for examination before being assigned to work. The FSA is responsible for making sure an inmate is cleared to return to work. Symptoms of vomiting and diarrhea and the 24-hour wait period are not specified. The relatively low frequency of norovirus outbreaks in correctional institutions observed in this report may suggest that they are adhering to the first 3 provisions.

The fourth CDC-recommended Food Code provision is not clearly stated in the BoP manual. As with other food establishments, high kitchen staff turnover in correctional institutions may make it difficult to maintain food safety among all food handlers. Often, food preparation and handling are performed by inmates under the super-vision of noninmate staff.<sup>5</sup> Having a certified food safety manager facilitates more consistent oversight and intervention when standards are not being met. At federal institutions, the FSA is responsible for developing food service staff training. The BoP manual does not say whether the FSA must be trained or include food safety in trainings. The FSA is responsible for but does not directly supervise inmate kitchen staff on food safety; this is the job of the cook supervisor. Although the manual states that food service staff must be qualified full-time food service employees and have a working knowledge of the BoP manual, it does not say whether they must have received training in food safety. State and local correctional institutions are not required by any federal regulatory agency to have a certified food protection manager, but some are by state or local code. Educating inmates on food safety in addition to having a food protection manager could provide a larger benefit to the general public, as the food industry is one of the main industries that hires ex-offenders and often participates in reentry programs.<sup>25</sup> Improving an inmate’s chances of being hired into the food industry may also help to reduce recidivism.<sup>26</sup>

### **Food Service Oversight and Regulation**

Approximately 2 million inmates are held in state and local institutions compared with 200 000 in federal institutions.<sup>1</sup> California and Florida reported the most foodborne outbreaks in correctional institutions, but they also had the second- and fourth-largest correctional populations<sup>1</sup> and reported the most foodborne outbreaks during the time period. Because federal institutions are regulated by the BoP and state and local institutions are not uniformly regulated by any state or federal agency, oversight and regulation of correctional institution kitchens by health departments varies by state and local jurisdiction. Investigative news reporters have found repeated non-compliance issues, failed inspections, and confusing

legal jurisdiction by regulatory agencies. In Kansas, nearly 340 inspections of state correctional facilities conducted from 2013 to 2014 revealed repeated non-compliance and deficiencies in food safety guidelines.<sup>27</sup> The findings highlight the difficulty of teaching and enforcing food safety guidelines among inmates who may be preparing food for distribution for the first time or not routinely adhering to personal hygiene practices.<sup>27</sup>

In 2015, lawmakers in Michigan attempted to clarify regulatory oversight of state prison kitchens after serious infractions by a prison food vendor resulted in hundreds of illnesses.<sup>28</sup> They set forth a pair of bills that would remove the exemption of prison kitchens as food establishments and require food vendors to pay for inspections.<sup>28</sup> Local and state health departments and federal regulatory agencies can provide oversight and enforce food safety at other food establishments, such as restaurants, by using fines and closures. However, even if these agencies inspect and identify violations in correctional institutions, facilities must continue to provide food to inmates.

### Limitations

Detecting outbreaks and case finding may be easier in institutionalized settings, so other outbreaks and outbreak-associated illnesses are more likely to be underreported. However, barriers to investigation in correctional institutions by health departments may result in underreporting of correctional outbreaks, especially for smaller outbreaks. This report included only outbreaks that were identified, investigated, and reported, which can vary by year and state on the basis of their capacity to perform these activities.<sup>10</sup> During the period of our study, the median annual number of all outbreaks reported declined and the incarcerated population increased from 1.8 million to 2.2 million.<sup>1</sup> For these reasons, comparison between years and states should be made with caution. Also, the true denominator for the at-risk incarcerated population may be higher than the estimates used to calculate illness per population in this report because the Bureau of Justice Statistics population estimates do not include all short-term jail admissions that may have occurred over the course of a year.<sup>1</sup> Only a small proportion of illnesses are identified as part of an outbreak and reported to FDOSS. Other limitations may include missing data and that common or easily identifiable pathogens or food sources may be more likely to be reported.

### Conclusions

Foodborne outbreaks in correctional institutions represent a notable portion of all foodborne outbreak-associated illness in the United States. Current food safety practices in correctional institutions have not been effective in reducing foodborne illnesses and outbreaks. Because inmates have little choice than to consume foods served by the correctional institution, it is imperative that those foods are safe. Public health action is needed to develop new intervention strategies for food safety training in correctional institutions and incorporate FDA Food Code into institutional guidelines. As many ex-offenders seek employment in the food industry, teaching food safety could be an opportunity to educate this future workforce while reducing the burden of foodborne illnesses among inmates.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## References

1. Bureau of Justice Statistics. Key statistics: estimated number of persons under correctional supervision in the United States, 1980–2014. Available at: <https://www.bjs.gov/index.cfm?ty=kfdetail&iid=487>. Accessed March 1, 2016
2. Institute for Criminal Policy Research. World prison population list. World Prison Brief. 2016. Available at: <http://www.prisonstudies.org>. Accessed February 2, 2016
3. Snell, TL. Correctional populations in the United States, 1991. Bureau of Justice Statistics Bulletin. 1993. NCJ 142729. Available at: <https://www.ncjrs.gov/pdffiles1/bjs/142729.pdf>. Accessed January 19, 2017
4. Minton, TD., Zeng, Z. Jail inmates at midyear 2014. Bureau of Justice Statistics Bulletin. 2015. NCJ 248629. Available at: <https://www.bjs.gov/content/pub/pdf/jim14.pdf>. Accessed January 19, 2017
5. Bick JA. Infection control in jails and prisons. Clin Infect Dis. 2007; 45(8):1047–1055. [PubMed: 17879924]
6. Cieslak PR, Curtis MB, Coulombier DM, Hathcock AL, Bean NH, Tauxe RV. Preventable disease in correctional facilities. Desmoteric foodborne outbreaks in the United States, 1974–1991. Arch Intern Med. 1996; 156(16):1883–1888. [PubMed: 8790084]
7. Levine WC, Smart JF, Archer DL, Bean NH, Tauxe RV. Foodborne disease outbreaks in nursing homes, 1975 through 1987. JAMA. 1991; 266(15):2105–2109. [PubMed: 1656108]
8. Bureau of Justice Statistics. Census of jails. Available at: <https://www.bjs.gov/index.cfm?ty=dcdetail&iid=254>. Accessed March 1, 2016
9. Stephan JJ. National Prisoner Statistics Program: census of state and federal correctional facilities, 2005. Bureau of Justice Statistics Bulletin. 2008 NCJ 222182.
10. Centers for Disease Control and Prevention. Surveillance for foodborne disease outbreaks—United States, 2008. MMWR Morb Mortal Wkly Rep. 2011; 60(35):1197–1202. [PubMed: 21900873]
11. Lynch M, Painter J, Woodruff R, Braden C. Surveillance for foodborne-disease outbreaks—United States, 1998–2002. MMWR Surveill Summ. 2006; 55(10):1–42.
12. Olsen SJ, MacKinnon LC, Goulding JS, Bean NH, Slutsker L. Surveillance for foodborne-disease outbreaks—United States, 1993–1997. MMWR CDC Surveill Summ. 2000; 49(1):1–62.
13. US Census Bureau. Annual estimates of the resident population for the United States, regions, states, and Puerto Rico: April 1, 2010 to July 1, 2014. Available at: <https://www.census.gov/data/tables/2016/demo/popest/nation-total.html>. Accessed March 1, 2016
14. Carson EA. Prisoners in 2014. Bureau of Justice Statistics Bulletin. 2015 NCJ 248955.
15. Dewey-Mattia D, Roberts VA, Vieira A, Fullerton KE. Foodborne (1973–2013) and waterborne (1971–2013) disease outbreaks—United States. MMWR Morb Mortal Wkly Rep. 2016; 63(55): 79–84. [PubMed: 27736832]
16. Bureau of Justice Statistics. Prisoners in 1983. Available from: <https://www.bjs.gov/content/pub/pdf/p83.pdf>. Accessed January 19, 2017
17. Sabol, WJ., Couture, H., Harrison, PM. Prisoners in 2006. Bureau of Justice Statistics Bulletin. 2007. NCJ 219416. Available at: <https://www.bjs.gov/content/pub/pdf/p06.pdf>. Accessed January 19, 2017
18. Scharff RL. Economic burden from health losses due to foodborne illness in the United States. J Food Prot. 2012; 75(1):123–131. [PubMed: 22221364]

19. Shandera WX, Tacket CO, Blake PA. Food poisoning due to *Clostridium perfringens* in the United States. *J Infect Dis.* 1983; 147(1):167–170. [PubMed: 6296240]
20. Grass JE, Gould LH, Mahon BE. Epidemiology of foodborne disease outbreaks caused by *Clostridium perfringens*, United States, 1998–2010. *Foodborne Pathog Dis.* 2013; 10(2):131–136. [PubMed: 23379281]
21. Labbe, RG. *Clostridium perfringens*. In: Doyle, MP., editor. *Foodborne Bacterial Pathogens*. New York, NY: Marcel Dekker; 1989. p. 192-234.
22. Prison Litigation Reform Act of 1995, 42 USC § 1997e
23. US Federal Bureau of Prisons. Food Service Manual. 2011. p. 470006 Available at: [http://www.acfsa.org/documents/stateRegulations/Fed\\_Food\\_Manual\\_PS\\_4700-006.pdf](http://www.acfsa.org/documents/stateRegulations/Fed_Food_Manual_PS_4700-006.pdf). Accessed March 1, 2016
24. Lipcsei L, Kambhampati A. Improving food safety through prevention: CDC's food safety prevention status report. *J Environ Health.* 2016; 79(2):46–48.
25. Lichtenberger E. Where do ex-offenders find jobs? An industrial profile of the employers of ex-offenders in Virginia. *J Correctional Educ.* 2006; 57(4):297–311.
26. Staton-Tindall M, Harp KL, Winston E, Webster JM, Pangburn K. Factors associated with recidivism among corrections-based treatment participants in rural and urban areas. *J Subst Abuse Treat.* 2015; 56:16–22. [PubMed: 25858761]
27. Dyke, AV. Kansas prisons yield repeat food safety violations. *The Topeka Capital-Journal.* Jan 4, 2015 Available at: <http://cjonline.com/news-state/2015-01-04/kansas-prisons-yield-repeat-food-safety-violations>. Accessed March 1, 2016
28. Michigan bills would extend safety inspections to state prison kitchens. *Food Safety News.* Jan 26, 2015 Available at: <http://www.foodsafetynews.com/2015/06/michigan-bills-would-extend-food-safety-inspections-to-state-prison-kitchens/#.WOejA5hU2ic>. Accessed March 1, 2016

TABLE 1

Number of Outbreaks, Median Number of Illnesses Per Outbreak, Illnesses, Hospitalizations, and Deaths by Year of First Illness Onset for Foodborne Correctional Institution Outbreaks and Other Foodborne Outbreaks: United States, 1998–2014

Correctional Institution Outbreaks													Other Outbreaks		
Year	III Per 100 000 Incarcerated			III Per 100 000 Nonincarcerated			Deaths, No.			Hospitalizations, No. (Range)			Deaths, No.		
	Outbreaks, No.	Median III (Range)	Ill, No.	Population <sup>e</sup>	Hospitalizations, No. (Range)	Deaths, No.	Outbreaks, No.	Median III (Range)	Ill, No.	Population <sup>b</sup>	Hospitalizations, No. (Range)	Deaths, No.			
1998	11	21 (4–75)	317	17	19	0	1306	6 (2–916)	26839	10	867	33			
1999	7	25 (5–85)	216	11	2	0	1330	6 (2–460)	24 683	9	596	10			
2000	13	20 (3–200)	718	37	2	0	1392	6 (2–736)	25315	9	726	22			
2001	19	32 (4–552)	1914	98	6	4	1228	7 (2–886)	23240	8	659	7			
2002	13	125 (7–950)	2284	112	26	1	1307	7 (2–700)	22655	8	708	13			
2003	10	96 (3–880)	2196	105	40	0	1 079	7 (2–964)	20883	7	647	24			
2004	15	30 (4–170)	678	32	16	0	1313	8 (2–707)	28356	10	763	22			
2005	12	46 (21–872)	1609	73	6	0	947	8 (2–738)	18152	6	586	8			
2006	14	47 (8–1644)	3175	141	10	0	1241	9 (2–1200)	25481	9	1160	10			
2007	13	98 (12–300)	1325	58	14	0	1075	8 (2–802)	19645	7	863	18			
2008	12	96 (6–471)	1578	68	4	0	1017	9 (2–1500)	21511	7	1242	22			
2009	10	87 (13–184)	918	40	3	0	659	9 (2–800)	12895	4	538	7			
2010	11	21 (2–250)	534	23	7	0	841	8 (2–1939)	15325	5	623	16			
2011	11	64 (4–352)	1005	45	3	0	784	8 (2–312)	13257	4	949	45			
2012	12	75 (4–365)	1210	54	18	0	820	8 (2–425)	13762	4	839	20			
2013	8	26 (4–133)	298	13	18	0	815	8 (2–634)	13130	4	1041	16			
2014	9	46 (4–206)	650	29	10	0	852	6 (2–294)	12576	4	699	21			
Total	200	44 (2–1644)	20625	45 (11–141)	204	5	18006	8 (2–1939)	337705	7 (4–10)	13506	314			

<sup>a</sup>Calculated using US Bureau of Justice Statistics estimates for total correctional population held in the custody of state and federal prisons or local jails; population survey midyear estimate does not include all persons admitted to local jails for short-term sentences over the course of the year.

<sup>b</sup>Calculated using US Census Bureau population estimates subtracting US Bureau of Justice Statistics incarcerated population estimates.

TABLE 2

Number of Outbreaks, Median Number of Illnesses Per Outbreak, Illnesses, Hospitalizations, and Deaths of Foodborne Correctional Institution Outbreaks and Number of Other Outbreaks by Etiological Agent: United States, 1998–2014

Etiological Agent	Other Outbreaks (n = 7353), No. (%)	Outbreaks (n = 128), No. (%)	Correctional Institution		
			Median Ill (Range)	Ill, No.	Hospitalizations, No. Deaths, No.
<i>Clostridium perfringens</i>	307 (4)	36 (28)	94 (10–950)	5566	41 0
<i>Salmonella</i>	1955 (27)	35 (27)	24 (3–552)	2848	70 5
Serotype enteritidis	588 (8)	16 (13)	15 (3–552)	985	12 0
Serotype typhimurium	281 (4)	6 (5)	38 (21–404)	657	24 4
Serotype heidelberg	142 (2)	5 (4)	26 (4–517)	606	6 0
Other serotype <sup>a</sup>	944 (13)	8 (6)	38 (4–250)	600	28 1
Norovirus	2910 (40)	21 (16)	58 (4–471)	1693	1 0
<i>Escherichia coli</i>	442 (6)	12 (9)	25 (6–209)	469	32 0
STEC 0157	383 (5)	10 (8)	17 (6–45)	208	29 0
ETEC	7 (< 1)	1 (1)	209 (209–209)	209	0 0
STEC 045	2 (< 1)	1 (1)	52 (52–52)	52	3 0
<i>Staphylococcus aureus</i>	189 (3)	8 (6)	40 (15–206)	447	1 0
<i>Campylobacter</i> species	289 (4)	6 (5)	78 (4–1644)	2009	9 0
<i>Bacillus cereus</i>	74 (1)	4(3)	49 (9–103)	210	0 0
<i>Clostridium botulinum</i>	43 (1)	4(3)	7 (4–8)	25	17 0
Ciguatoxin	215 (3)	1 (1)	2 (2–2)	2	0 0
Histamine	36 (< 1)	1 (1)	13 (13–13)	13	0 0
Other	893 (12)	0 (0)	...	...	... ...

Note. ETEC = enterotoxigenic *E. coli*; STEC = shiga toxin-producing *E. coli*.

<sup>a</sup> All other *Salmonella* serotypes had only 1 associated correctional institution outbreak. Death was attributable to *Salmonella* serotype miami.

**TABLE 3**

Implicated Food Category in Correctional Institution and Other Outbreaks: United States, 1998–2014

Food Category	Correctional Institution Outbreaks, No. (%)	Other Outbreaks, No. (%)
Poultry	16 (20)	469 (7)
Vegetables	9 (11)	406 (6)
Meat	7(9)	699 (10)
Dairy	5(6)	241 (4)
Grains or beans	4 (5)	116 (2)
Fish	3 (4)	663 (10)
Eggs	2 (2)	132 (2)
Fruits	0 (0)	176 (3)
Game	0 (0)	19 (0)
Nuts or seeds	0 (0)	19 (0)
Oils or sugars	0 (0)	10 (0)
Shellfish or other aquatic	0 (0)	272 (4)
Multiple	27 (33)	2818 (42)
Unclassifiable	9 (11)	714 (11)
Total	82 (100)	6754 (100)